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Inventor: Marino, M.)
) **DECLARATION OF DR. ROBERT**
) **A. KOSLOVER UNDER RULE 132**
For: LOW-POWER/WIDEBAND TRANSFER)
FUNCTION MEASUREMENT METHOD)
AND APPARATUS)
)

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on

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Robert A. Koslover states:

1. I am a citizen of the United States of America.

2. Currently, I am a senior scientist at SARA, Inc. specializing in electromagnetics research. I received my PhD in experimental plasma physics from the University of California, Irvine, in 1987. My publications include two patents (5,323,169 and 4,999,591) and numerous journal articles spanning high-power antennas, high-speed microwave data

acquisition & diagnostic systems, high-power RF sources, and experimental plasma physics. I am a member of the IEEE Antennas and Propagation Society, the American Physical Society, and the Sigma Pi Sigma Physics Honor Society. In 19~~6~~ 9 R.K. 6 I was elected to membership in the International Union of Radio Scientists (URSI). My scientific accomplishments are further evidenced by a two-page listing attached hereto.

3. The attached paper is a result of my review of the CASSPER® patent application and claims, as they have been modified by this Amendment, and my review of the patents to Krayeski et al (5,471,146), Russell et al (4,663,744), and Henry, Jr. (5,991,622). I have placed photographs in this paper that are not reproduceable in this Amendment A or in the form used by Attorney John J. Murphey who has prepared Amendment A. However, my comments are every bit as relevant in this independent format as they would have been in this format.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Robert A. Koslover

Date: July 5, 2000 Robert A. Koslover

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Some Comments on the Uniqueness and Value of the CASSPER Distributed Network Analyzer

Prepared by

Dr. Robert A. Koslover[1]
June 14, 2000

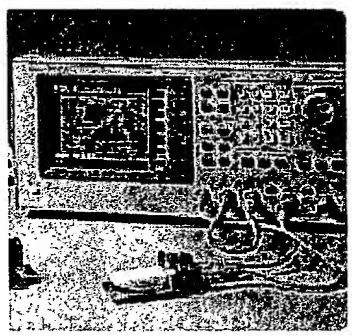
In my view, there are two particularly important features of SARA's CASSPER system that set it apart from other tools that one might employ for comparable purposes:

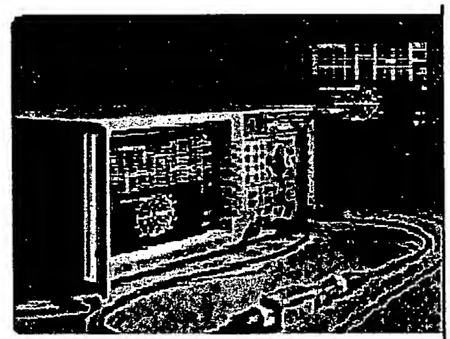
1. The application of the *Low-Power Wideband (LPWB) test technique*; and
2. The *distributed nature* of the system, with the individual units connected by fiber-optic links (in a synchronous phase-locked configuration).

The combination of these two features makes CASSPER much more suitable for certain kinds of transfer function measurements than traditional vector network analyzers, although the latter remain the primary tools in use today. Traditional network analyzers, of course, are particularly well-suited to direct transfer-function characterizations of *individual circuits, components, and devices* in a bench-top laboratory environment (see Fig. 1 below). It is important to note that the CASSPER system is *not* claimed to offer any significant advantages in such applications.

Figure 1. Example usage of conventional network analyzers to characterize components.

*Pictures borrowed from: "Hints for making Better Network Analyzer Measurements," Agilent Technologies, Application Note 1291-1.





Note that the example devices under test (DUTs) shown in Fig. 1 have both their input and output connections: (1) located near each other (allowing convenient connection to the analyzer); and (2) coupled to one another entirely inside the DUT, via a path that is relatively well-shielded from the external environment. When *either* of these conditions does not hold (and *especially* when the 2nd condition does not hold), the application of these traditional methods, though often still workable, can become a significant and costly endeavor. In stark contrast, these are the conditions under which SARA's CASSPER system excels.

Consider, for example, the challenge of measuring the transfer function between the terminals of two antennas (or similar devices) that are separated in space. In such circumstances, the input

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and output are *not* located near each other, and their coupling is via a path that is quite likely to suffer interference from (and which may interfere with) the external environment. Specifically:

(1) The coaxial cables that extend from the network analyzer to the spatially-separated terminals yield unintentional conduits, forming transmission lines between the cable shields and the ground. These undesired paths can alter the environment, and likewise the coupling, between the two antennas. Steps must thus be taken to ensure that these undesirable couplings do not compromise the measurement.

(2) The narrowband signals radiated by the source antenna can, in some circumstances, interfere with communications or other RF traffic in the area at the same frequencies. Such interference has been observed, and has caused problems, in areas around airports.

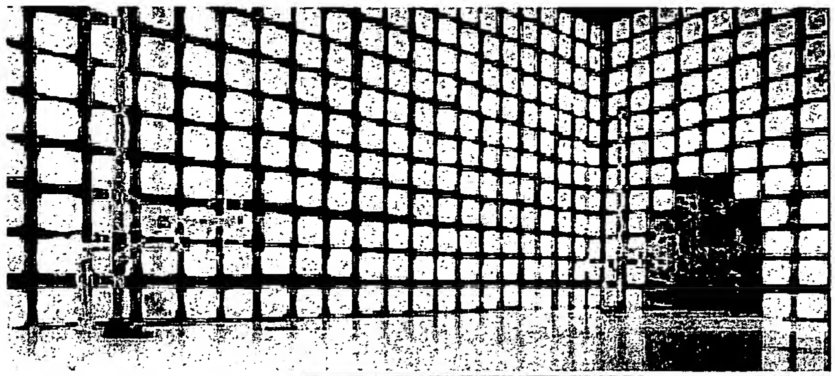

Figure 2. Accurate transfer function measurements made by traditional means often require placement of the systems in special chambers, as well as careful placement of test cables to avoid interference with the measurements.

*Pictures borrowed from: EMC Test Systems, Inc.

Network analyzers are located remotely from the devices under test, and cabled to them via carefully-chosen paths into and out of the chamber.

The *distributed* nature of the CASSPER network analyzer system allows the receivers to be placed very near the DUT ports. These receivers are then linked via *fiber-optic cables* that carry digital information, not the raw RF signals, to a centralized control unit. In contrast to coaxial cables, the fiber optic links do *not* introduce undesirable conduits for RF signals into the test environment.

Although fiber optic lines can be used (and sometimes have been used) with conventional network analyzers, unfortunately the need to support the full frequency range of the stepped or swept signal reduces the dynamic range[2] substantially. In contrast, the CASSPER control unit conveys a common digital signal to all the distributed receivers, phase-locking them to the transmitted RF signal. These receivers then digitize locally down-converted received signals, all synchronized to the same clock. These steps preserve the phase information and eliminate the

[2] Ratio of maximum to minimum useable power levels, normally expressed in dB.

problem of reduced dynamic range, since only digital signals are being exchanged over the fiber optic link. It should be emphasized that the synchronization of the distributed units is essential for this to work. One cannot achieve the same ends by simply distributing two or more conventional network or spectrum analyzers, since there is no practical way to phase-lock these independent units internally.

The incorporation of the LPWB test technique directly addresses the separate problem of potential interference with external communications systems. The trick here is to replace the narrowband swept or stepped frequency approach of a conventional network analyzer with a continuous broadband signal of very low power within any particular communication band, thus becoming effectively non-perturbing within those bands (see Fig. 3). The CASSPER system can operate successfully at such a low power only because of its combination of coherence-based detection with repetitive averaging, which when taken together, boost the signal-to-noise ratio. (Alternative wideband techniques, such as those based on short pulses rather than continuous signals, do not support coherence-based detection.)

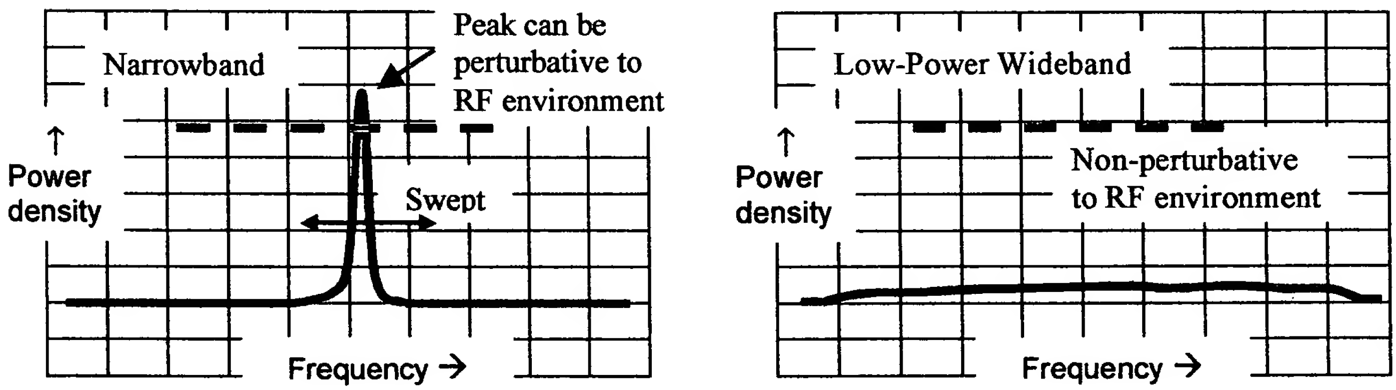

Figure 3. The conventional narrowband swept method yields a power spectrum (left) where radiated signals may be perturbative to external systems. In contrast, the LPWB method (right) minimizes the spectral power density, and is thus effectively non-perturbative.

The aforementioned features of the CASSPER system are especially important when large systems, such as aircraft, ships, or buildings need to be tested for RF shielding effectiveness. Figure 4 (next page) provides one such example. The complexity and cost of attempting to make such measurements by conventional means is well known.

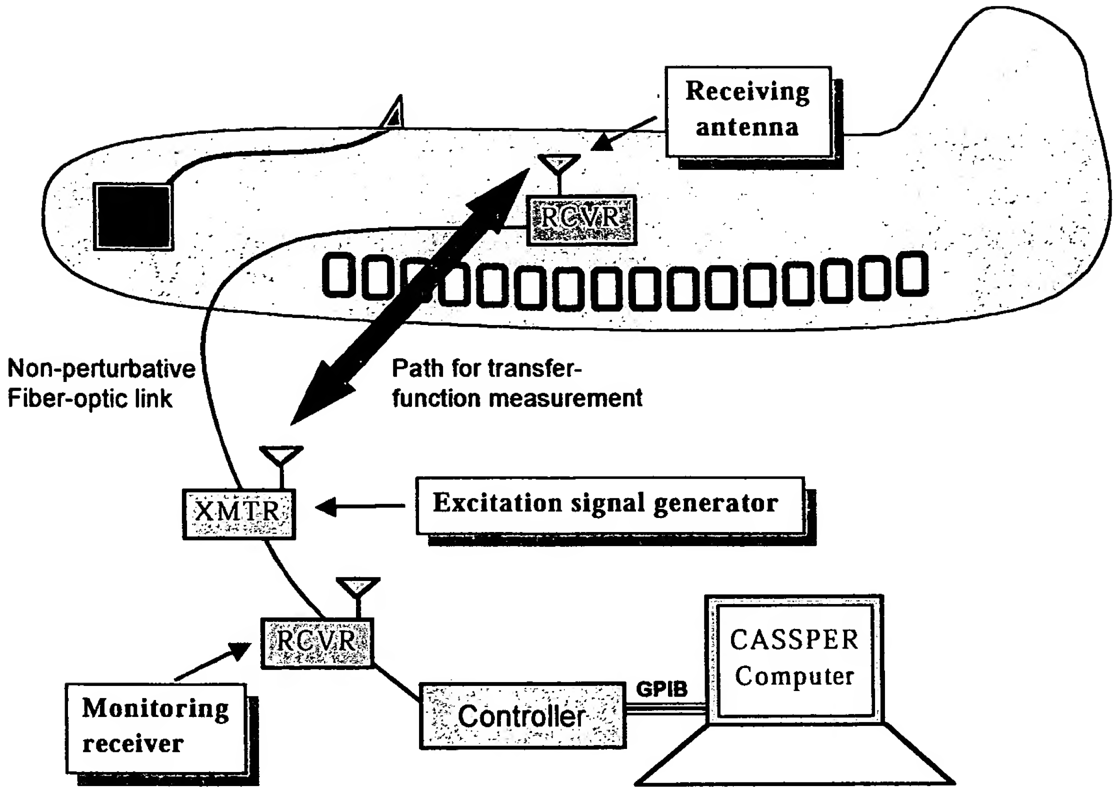

Figure 4. Example application of CASSPER for measurement of aircraft shielding effectiveness. CASSPER's distributed receivers and fiber optic links (which avoid violating the RF integrity of the aircraft) plus use of the LPWB test technique (avoiding interference with nearby communications) are particularly valuable in these kinds of tests.

Dr. Robert A. Koslover, *Senior Scientist*

Dr. Koslover has 11 years of experience in electromagnetics research for defense applications. He is currently the Principal Investigator for an L-band HPM antenna development effort sponsored by the US Army Research Laboratory (ARL), as well as an EMI diagnostic system being developed for the US Air Force Research Laboratory (AFRL). He holds two patents in high power electromagnetics and has published several research papers concerning HPM and UWB antennas, high peak-power RF sources, high-speed microwave diagnostic systems, and plasma physics.

From 1993-97, Dr. Koslover was a Research Physicist for the USAF Phillips Laboratory (PL, now AFRL) at Kirtland AFB, NM. There, he provided detailed technical review and direction for R&D efforts in advanced RF, microwave, and laser-based technologies. In 1993, he assembled and led a team of USAF and contractor scientists on a visit to five major laser and microwave research institutes in Moscow. In related work at PL, he developed computer simulations of charged particle motions in laser-plasma generated magnetic fields.

From 1987-93, Dr. Koslover worked as a contractor scientist supporting the USAF in the performance of HPM source and antenna development, effects testing, and related research. He co-founded Voss Scientific in Albuquerque, NM, in 1988, and subsequently served as Principal Investigator for three USAF contracts involving HPM antenna design and analysis, effects testing, characterization of non-ideal anechoic chamber environments, and development of advanced multi-channel RF diagnostic systems. He also participated in the design of novel electron-beam driven HPM sources. In prior work, at SEA (Albuquerque, NM), he was the Principal Investigator for an electromagnetic modeling project sponsored by an Air Force SBIR in 1988. In the spring of 1988, he became SEA's acting Program Manager for a USAF contract to perform HPM source development and effects testing.

Dr. Koslover received his PhD in experimental plasma physics from the University of California, Irvine (UCI) in 1987, as well as his M.S. and B.S. (cum laude) degrees in physics from UCI in 1983 and 1981. He is also a graduate of the USAF Air Command and Staff College (assoc. program) and an *Outstanding Graduate* of the USAF Air War College (assoc. program). He is a member of the American Physical Society, the Sigma Pi Sigma Physics Honor Society, and the IEEE Antennas and Propagation Society. In 1996, he was elected to membership in the International Union of Radio Scientists (URSI).

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